CLAIMS

1. Method of treating a raw fluid to be treated by flocculation and separation charged with impurities in suspension, colloidal impurities or dissolved impurities, wherein:

- the raw fluid to be treated is circulated with a flocculating reagent in a flocculation vat to obtain a flocculated mixture in which the impurities form flocs, and

- this flocculated mixture is circulated in a separation area in which the flocculated mixture is separated into clarified effluent and sludge containing the flocs,

characterized in that:

* a completely immersed flow-guide tube delimits a central area in the flocculation vat in which agitation (8) brings about turbulent axial flow of the mixture of the raw fluid to be treated and the flocculating agent in an axial direction of the flow-guide tube,

* that flow is divided (5) angularly by means of a static system opposing rotation of the flow disposed at the flow-guide tube outlet,

* this mixture is allowed to circulate in an opposite direction in a peripheral area (3) around the central area in order to reach the inlet of the central area, and

* a fraction of the mixture is passed to the separation area.

2. Method according to claim 1, characterized in that the flow in the central area is maintained at a flowrate from 1 to 20 times the inlet flowrate of the raw fluid to be treated.

3. Method according to claim 1 or claim 2, characterized in that the peripheral area is divided into an upstream peripheral area communicating with the inlet

into the flocculation vat for raw fluid to be treated and a downstream peripheral area communicating with the flocculated mixture outlet, so as to cause the raw fluid to be treated that enters the flocculation vat to enter the central area at least once before passing to the separation area.

4. Method according to any one of claims 1 to 3, characterized in that the turbulent axial flow of the mixture is vertical.

5. Method according to claim 4, characterized in that the vertical turbulent axial flow is brought about by agitation (8) at mid-height in the central area.

6. Method according to claim 5, characterized in that the turbulent axial flow of the mixture is downward and the mixture is divided angularly over at least substantially two thirds of the height between the level of the outlet from the central area and the level of the bottom of the flocculation vat.

7. Method according to claim 6, characterized in that the mixture is divided angularly over substantially all of the height between the level of the central area and the level of the bottom of the flocculation vat.

8. Method according to claim 6 or claim 7, characterized in that the flow-guide tube delimiting the central area is disposed so that its bottom end forming its outlet faces the bottom of the flocculation vat at a distance from 1/3 to 2/3 the average width of the tube therefrom.

9. Method according to claim 8, characterized in that the flow-guide tube delimiting the central area is disposed so that its top end forming its inlet faces the surface of the contents of the flocculation vat at a distance from 1/3 to 2/3 of the average width of the tube therefrom.

10. Method according to any one of claims 6 to

9, characterized in that the peripheral area is divided over an upper portion of its height into an upstream peripheral area communicating with the inlet into the flocculation vat for the raw fluid to be treated and a downstream peripheral area communicating with the flocculated mixture outlet, so as to cause the raw fluid to be treated entering the flocculation vat to enter the central area at least once before passing to the separation area.

11. Method according to claim 10, characterized in that said division is effected over substantially the upper half of that height.

12. Method according to any one of claims 4 to 11, characterized in that the raw fluid to be treated enters and the flocculated mixture leaves substantially at the level of the inlet area of the flow-guide tube.

13. Method according to any one of claims 1 to 12, characterized in that the flocculating agent is a natural, mineral or synthetic polymer.

14. Method according to any one of claims 1 to 13, characterized in that the flocculating reagent with which the raw fluid to be treated is mixed in the flocculation vat is introduced into the fluid to be treated upstream of said vat.

15. Method according to any one of claims 1 to 13, characterized in that the flocculating reagent with which the raw fluid to be treated is mixed is introduced into the flocculation vat.

16. Method according to claim 15, characterized in that the flocculating reagent is introduced between the inlet of the flocculation vat and the inlet of the flow-guide tube.

17. Method according to claim 15, characterized in that the flocculating reagent is introduced into the central area.

18. Method according to claim 15, characterized in that the flocculating reagent is introduced at the boundary of the central area.

19. Method according to claim 18, characterized in that at least a fraction of the flocculating reagent is injected annularly at the periphery of the inlet of the central area and coaxially with the flow-guide tube.

20. Method according to any one of claims 1 to 19, characterized in that a powder is mixed with the raw fluid to be treated in the flocculation vat.

21. Method according to claim 20, characterized in that the powder is a ballast consisting of an insoluble granular material heavier than the raw fluid to be treated.

22. Method according to claim 21, characterized in that the ballast consists of fine sand with a particle size range from 20 to 300 microns.

23. Method according to claim 21 or claim 22, characterized in that the sludge is treated at the outlet from the separation area, where ballast is recovered and recycled to the flocculation vat.

24. Method according to any one of claims 1 to 23, characterized in that the raw fluid to be treated is mixed with coagulating agent before it is introduced into the flocculation vat.

25. Method according to any one of claims 1 to 24, characterized in that the main fluid is water to be treated.

26. Method according to claim 25, characterized in that the water to be treated is mixed with a coagulating agent including a mineral salt such as an iron or aluminium salt before it is introduced into the flocculation vat.

27. Method according to any one of claims 1 to 26, characterized in that separation is effected by

sedimentation.

28. Method according to any one of claims 1 to 26, characterized in that separation is effected by flotation.

29. Method according to claim 27 or claim 28, characterized in that separation is effected with the assistance of separation aid members such as inclined or vertical tubes or plates.

30. Method according to any one of claims 27 to 29, characterized in that the flocculated mixture is introduced tangentially into the separation area so as to combine a vortex effect with the sedimentation effect.

31. Reactor for treating a raw fluid to be treated by flocculation charged with impurities in suspension, colloidal impurities or dissolved impurities, including a vat (10, 10', 10") having a fluid inlet, a fluid outlet and a flocculation area in a bath in which the fluid to be treated is mixed with a flocculating agent, said reactor including:

- a flow-guide tube (2A) open at both ends and disposed vertically so that it is completely immersed in the bath in the vat but remains at a distance from the bottom of the vat, delimiting a central area (2) from a peripheral area (3), the central and peripheral areas communicating with each other at both ends of the tube and the peripheral area communicating with the fluid inlet and outlet,

- a vertical-axis agitator (8) disposed in the tube so as to generate therein vertical turbulent axial movement,

- a cruciform baffle (5) formed of a plurality of vertical walls extending horizontally from a common edge (7) substantially aligned with the axis of the agitator, on the downstream side thereof, so as to divide angularly the flow towards the peripheral area leaving the tube.

32. Reactor according to claim 31, characterized in that the flow-guide tube has a constant section.

33. Reactor according to claim 32, characterized in that the flow-guide tube has a cylindrical shape.

34. Reactor according to any one of claims 31 to 33, characterized in that the agitator is disposed substantially at mid-height in the tube.

35. Reactor according to any one of claims 31 to 34, characterized in that the flow-guide tube has a diameter from 102% to 120% of the diameter of the agitator.

36. Reactor according to any one of claims 31 to 35, characterized in that the hydraulic diameter of the central area is from 40% to 60% of the average width of the flocculation area formed by the central area and the peripheral area.

37. Reactor according to any one of claims 31 to 36, characterized in that the agitator is disposed and driven so as to generate a downward vertical movement in the tube, the cruciform baffle being disposed between the bottom of the flow-guide and the bottom of the vat.

38. Reactor according to claim 37, characterized in that the tube has a bottom end facing the bottom of the vat at a distance from 1/3 to 2/3 of its diameter therefrom.

39. Reactor according to claim 38, characterized in that the tube has a top end facing the surface of the bath contained in the vat at a distance from 1/3 to 2/3 of its diameter therefrom.

40. Reactor according to any one of claims 37 to 39, characterized in that the distance between the bottom end of the tube and the bottom of the vat and the distance between the top end of the tube and the level of the bath are at least approximately 50% of the diameter of the tube.

41. Reactor according to any one of claims 37 to 40, characterized in that the cruciform baffle has a height substantially equal to at least 2/3 of the distance between the bottom end of the tube and the bottom of the vat.

42. Reactor according to claim 41, characterized in that the cruciform baffle has a height substantially equal to the distance between the bottom end of the tube and the bottom of the vat.

43. Reactor according to any one of claims 37 to 42, characterized in that the vertical walls of the cruciform baffle extend over a horizontal distance substantially from 3/4 to 5/4 of the radius of the tube.

44. Reactor according to claim 43, characterized in that the vertical walls of the cruciform baffle extend over a horizontal distance substantially equal to the radius of the flow-guide tube.

45. Reactor according to any one of claims 37 to 44, characterized in that the cruciform baffle comprises four walls offset at 90° around the axis of the flow-guide tube.

46. Reactor according to claim 45, characterized in that two of the walls are disposed transversely to the direction in which the raw fluid to be treated enters the flocculation vat.

47. Reactor according to any one of claims 37 to 46, characterized in that vertical walls divide the peripheral area between said inlet and outlet areas over at least a portion of the total height between the bottom of the vat and the surface of the bath.

48. Reactor according to claim 47, characterized in that these vertical walls extend over a vertical distance from 40% to 60% of the total height.

49. Reactor according to claim 47 or claim 48, characterized in that the reactor includes two or more

vertical baffles extending substantially over the upper half of the vat, between the flow-guide tube, the fluid inlet and the fluid outlet, respectively, so as to cause the fluid to be treated to enter the central area between the fluid inlet and the fluid outlet at least once.

50. Reactor according to any one of claims 47 to 49, characterized in that the vertical walls extend over a height between the main fluid inlet level and the level of the agitator.

51. Reactor according to any one of claims 47 to 50, characterized in that the vertical walls extend from the periphery of the peripheral area to the tube.

52. Reactor according to any one of claims 37 to 51, characterized in that the inlet and outlet areas are near the level of the surface and each is provided with a transverse plate facing the inlet and the outlet, respectively, to form a siphon.

53. Reactor according to any one of claims 31 to 52, characterized in that it further comprises a flocculating reagent injection tube connected to a supply of flocculating reagent.

54. Reactor according to claim 53, characterized in that the flocculating reagent injection tube is situated between the inlet for raw fluid to be treated and the inlet of the flow-guide tube.

55. Reactor according to claim 53, characterized in that it includes an annular flocculating reagent injection tube coaxial with the inlet of the flow-guide tube.

56. Reactor according to any of claims 31 to 55, characterized in that it further comprises a powder injection tube connected to a supply of powder.

57. Reactor according to claim 56, characterized in that the supply of powder is a supply of fine sand.

58. Reactor according to any one of claims 31 to

57, characterized in that the vat includes a single flocculation area including a flow-guide tube.

59. Fluid treatment installation including a reactor according to any one of claims 31 to 57 and a separation area connected to the outlet of the vat of the reactor.

60. Installation according to claim 59, characterized in that the reactor comprises a powder injection tube connected to a powder supply and the separation area includes an outlet connected to a powder recovery system and adapted to collect sludge containing flocs, said powder supply being connected to said recovery system.

61. Installation according to claim 59 or claim 60, characterized in that the separation area is a sedimentation unit on the downstream side of the vat.

62. Installation according to any one of claims 59 to 61, characterized in that the separation area is a sedimentation unit around the vat.